FUEL ECONOMIZER - 50 TPD

ORISSA SPONGE IRON CLUSTER

BEE, 2010
Detailed Project Report on Fuel Economizer - 50 TPD
Sponge Iron SME Cluster, Rourkela,Orissa (India)
New Delhi: Bureau of Energy Efficiency;
Detail Project Report No.: **ORSA/SPONGE/FEZ/01**

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Acknowledgement

We sincerely appreciate the efforts of industry, energy auditors, equipment manufacturers, technology providers, consultants and other experts in the area of energy conservation for joining hands with Bureau of Energy Efficiency (BEE), Ministry of Power, and Government of India for preparing the Detailed Project Report (DPR) under BEE SME Program in SMEs clusters. We appreciate the support of suppliers/vendors for providing the adoptable energy efficient equipments/technical details to the SMEs.

We have received very encouraging feedback for the BEE SME Program in various SME Clusters. Therefore, it was decided to bring out the DPR for the benefits of SMEs. We sincerely thank the officials of BEE, Executing Agencies and ISTSL for all the support and cooperation extended for preparation of the DPR. We gracefully acknowledge the diligent efforts and commitments of all those who have contributed in preparation of the DPR.

CONTENT

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Lists of Abbreviations

BEE	- Bureau of Energy Efficiency
DPR	- Detailed Project Report
DSCR	- Debt Service Coverage Ratio
GHG	- Green House Gases
HP	- Horse Power
IRR	- Internal Rate of Return
MoP	- Ministry of Power
MoSME	- Micro Small and Medium Enterprises
NPV	- Net Present Value
ROI	- Return On Investment
SIDBI	- Small Industrial Development Bank of India
SME	- Small and Medium Enterprises

EXECUTIVE SUMMARY

APITCO Ltd. is executing BEE-SME program in Orissa Sponge Iron Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Rourkela and Sundargarh area is renowned for Sponge iron manufacturing business and is a big hub for sponge iron supply. There are about 107 sponge iron units in the cluster and majority of industries located in Sundargarh area engaged in production of sponge irons which further converted into billets through induction furnace for further use.

The major Energy consumption in sponge Iron cluster is of thermal energy derived from coal and electrical energy from grid electricity. Electricity is used for supplying energy for motor driven drives like kiln min drive, cooler main drive, crushers, bag filters, pumps, ESPs etc. and also for lighting purpose. If the percentage share of the total energy consumption is considered then the electrical is not more than 2% where as the remaining 98% is the thermal energy requirement. HSD is used as fuel in DG sets for generation of electricity during the power failure from Electricity board.

In the plant it is observed that a good amount of heat energy is expelled out of the kiln in the form of waste gases, more over an extra amount of electrical energy is given via forced draft fan to reduce the heat content of the flue gases for the environmental concern. The flue gases from the kiln's ore feeding end contains a good percentage of carbon monoxide which is further burnt in the ABC i.e. the After Burning Chamber which causes rise in the outlet flue gases temperature. The waste heat of the flue gases can be used for preheating the inlet ore which results in the reduction of coal consumption as the kilo calories required for heating the iron ore is already been supplied by the waste heat of the flue gases in the suggested fuel economizer arrangement.

The DPR highlights the details of study conducted for assessing the potential for reducing thermal energy consumption during operation by installing fuel economizer at the various units in the cluster, possible energy savings and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of project Implementation.

Total investment required and financial indicators calculated such as debt equity ratio, monetary saving, IRR, NPV, DSCR and ROI etc for proposed technology is furnished in Table below:

S. No.	Particular	Unit	Value
1	Project cost	(in Lakh)	140
2	Coal Savings	Tons/annum	1548
3	Monetary benefit	(in Lakh)	46.43
4	Simple payback period	Months	42
5	NPV	(in Lakh)	13.74
6	IRR	percentage	13.57
7	ROI	percentage	28.62
8	Average DSCR	Ratio	1.44
9	Increase in production	percentage	20

The projected profitability and cash flow statements indicate that the project implementation i.e. installation of fuel economizer will be financially viable and technically feasible solution for the cluster.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 29 selected SMEs clusters. Orissa Sponge Iron Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

Major activities in the BEE -SME program are furnished below:

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion

1 INTRODUCTION

1.1 Brief Introduction about cluster

The state of Orissa is located in the South –East coast of India in the banks of Bay of Bengal. The state capital is Bhubaneswar. It is renowned for the Sponge Iron business. They even export to various countries throughout the world.

There are about 107 sponge iron industries in the cluster and majority of industries are located in Orissa.

The major Energy consumption in Ice making cluster are thermal energy from coal and grid electricity. Electricity is used for driving the prime movers of installed in the plants i.e. Reduction Kiln main drive, Cooler Kiln main, air compressors, pumps, and other drives and even for lighting purpose. The majority of the energy share is by the thermal energy drawn by burning coal which comes out to be around 98% of the total energy consumption the remaining is by the electrical energy.

1.1.1 Production process

Non-coking coal and iron ore along with limestone in the required size range and quantity are continuously fed into the feed – end of the inclined rotary kiln through a feed pipe. The materials move along the length of the kiln due to its inclination and rotation. Air is blown in through required number of air tubes suitably located along the length of the kiln. At the feed-end of the kiln air is blown in through nozzles for drying and pre heating of the charge. Initial heating of the kiln is carried through a central oil burner located at the discharge feed end. As the charge moves through the kiln, it is heated by the hot gases, which flow in the opposite direction to the charge (i.e. counter current flow). The initial part of the kiln (about 30%) is called the pre heating zone, where moisture in the charge and volatiles in the coal are removed / burnt off as waste gases. The required heat in this zone is provided by the combustion of the feed coal. The remaining portion of the kiln is called as the reduction zone. In this zone, oxygen in the iron ore is removed leaving metallic iron as per the following chemical reaction.

$3FeO_3 + CO \leftarrow\text{----------}\rightarrow 2\ Fe_2O_4 + CO_2$

$Fe_2O_4 + CO \leftarrow\text{----------}\rightarrow 3FeO + CO_2$

$FeO + CO \leftarrow\text{----------}\rightarrow Fe + CO_2$

The CO is generated for the above reaction according to $CO_2 + C \rightarrow 2CO$, at temperature above 900 deg. C, carbon monoxide will combine with the oxygen in the iron ore forming carbon dioxide and thus reduce the ore to metallic state.

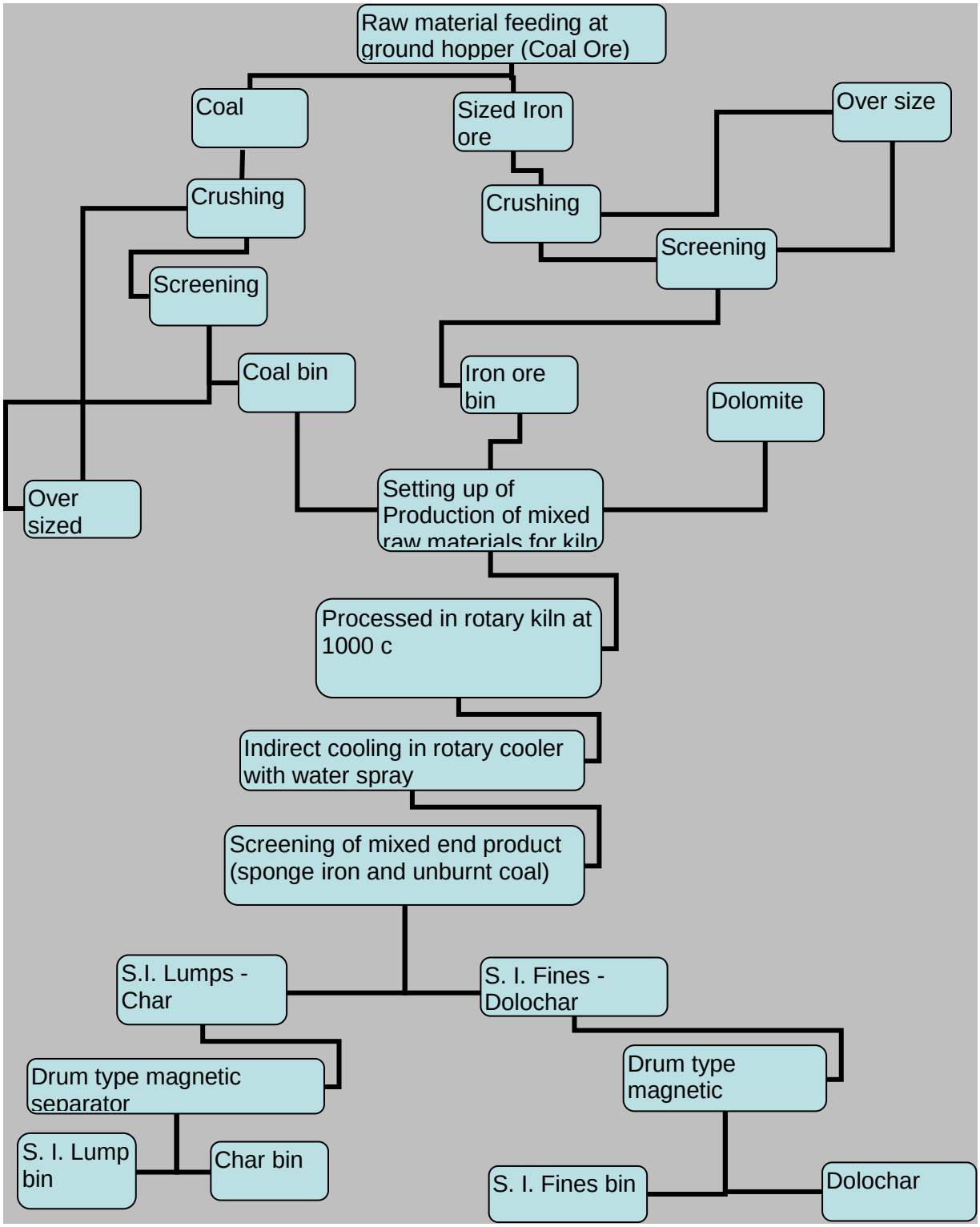
Higher the temperature, the faster would be the oxygen removal. After the removal of oxygen and grater is the metallization of sponge iron. Metallization levels can roughly be checked by density of the sponge iron. It can also be judged by the metallic luster if a sample is rubbed against a rough surface.

After the iron ore has been metallic to the desired level, sponge iron and residual char are discharged from the kiln into a rotary drum type cooler. In the cooler sponge iron is cooled to below 60^0C before the material is discharged on to a belt conveyor. If the sponge iron were exposed to air at high temperatures (about 150^0C) it would tend to re oxidize. It is therefore, necessary that the temperature of the product at the point of discharge from the cooler is as close as possible to the ambient temperature. The reduction process occurs in solid state. The crucial factor in this reduction process is the controlled combustion of coal and its conversion to carbon monoxide to remove oxygen from the iron ore.

The overall process extends to a period of 10 to 12 hours inside the kiln. During this time, iron ore is optimally reduced and the hot reduced sponge iron along with semi-burnt coal is discharged to a rotary cooler for indirect cooling to a temperature of around 120°C. Sponge iron being magnetic in nature, the discharge from cooler main drive consisting of sponge iron, chars & other contaminations are routed through electromagnetic separators, to separate other impurities from sponge iron. The product is then screened in size fractions of lump (+3mm) and fines (0-3 mm). Separate bins are installed to preserve its quality, reduce re oxidation and facilitate faster loading on to the trucks.

Detailed of process flow chart are finished in Figure 1.1 below:

Figure 1.1: General process flowchart of a typical Sponge Iron unit



1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption of a typical unit in the cluster

The main energy used in a typical sponge iron industry is the thermal energy derived from coal and electrical energy from grid supply. Electricity is used for driving the prime movers like kiln drives, compressors, pumps, Bag filters, crushers, FD and ID fans etc. and even for lighting power consumption. The energy consumption details are given below in the Table 1.1 below:

Table 1.1: Energy consumption of typical units have 50 TPD kiln

S. No	Name of Industries	TPD	No. of 50 TPD Kiln	No. of 100 TPD Kiln	Annual Production	Annual Electricity consumption (millions of kWh)	Annual Coal Consumption (Tons/annum)
1	Agrasen Sponge Iron Pvt. Limited	150	1	1	42154	5.10	65573
2	Bajrang Ispat Limited	100	2		29900	2.89	40210
3	Bhagbati Steels Pvt Ltd	50	1		11200	0.80	15062
4	Jaganath Sponge Private Limited	50	1		14800	1.56	20086
5	Kendriya Ispat Pvt .Ltd	50	1		11850	1.45	15936
6	Maa Tarani Industries Private Ltd	100	2		27400	3.47	36848
7	Maha Kali Ispat Private Limited	50	1		14000	2.20	19000
8	Meta Sponge Private Limited	100	2		26400	3.25	35503
9	Pavan jay Sponge Limited	100	2		27200	3.14	36579
10	Prabhu Sponge Iron Pvt Ltd	200	4		49000	5.00	65897
11	Seeta Integrated Steels and Energy Ltd.	150	1	1	35600	4.10	55378
12	Shri Balaji Metallics Pvt Ltd	100	2		28900	3.48	38533
13	T.R Chemicals Limited	150	3		46800	4.80	62938
14	Utkal Metallic Limited	100	2		25689	3.12	34547

1.2.2 Average production by a typical unit in the cluster

The average productions in a sponge iron unit depend on the installed TPD for a single 50 TPD kilns it varies in between 11200 to 14000 tons per annum.

1.2.3 Specific Energy Consumption

For production of sponge iron both thermal and electrical energy are required. The major share of the energy is for the thermal energy which is around 98 % and the remaining is of the electrical energy. The over all specific energy consumption of the units is given below:

Table 1.2: Specific energy consumption for typical units with 50 TPD kilns

S. No	Name of Industries	TPD	No. of 50 TPD Kiln	No. of 100 TPD Kiln	Annual Production	Over all Specific energy consumption (TOE/ Tons)
1	Agrasen Sponge Iron Pvt. Limited	150	1	1	42154	0.48
2	Bajrang Ispat Limited	100	2		29900	0.41
3	Bhagbati Steels Pvt Ltd	50	1		11200	0.41
4	Jaganath Sponge Private Limited	50	1		14800	0.42
5	Kendriya Ispat Pvt .Ltd	50	1		11850	0.41
6	Maa Tarani Industries Private Ltd	100	2		27400	0.41
7	Maha Kali Ispat Private Limited	50	1		14000	0.42
8	Meta Sponge Private Limited	100	2		26400	0.41
9	Pavan jay Sponge Limited	100	2		27200	0.41
10	Prabhu Sponge Iron Pvt Ltd	200	4		49000	0.41
11	Seeta Integrated Steels and Energy Ltd.	150	1	1	35600	0.48
12	Shri Balaji Metallics Pvt Ltd	100	2		28900	0.41
13	T.R Chemicals Limited	150	3		46800	0.41
14	Utkal Metallic Limited	100	2		25689	0.41

1.3 Existing technology/equipment

1.3.1 Description of existing technology

In the present condition there is no arrangement for the recovery of the waste heat which is expelling out of the kiln. The pre heating is of the ore is done in the 1st zone of the kiln where the temperature reaches to 700^{0}C, just before the reduction zone. And the heat contained in the flue gas is force fully reduced by the help of the FD fans or GCT arrangements just after the ABC chamber. The heat contained in the flue gas coming out of the kiln is made to increase more in ABC as because the unburned carbon monoxide is made to burn in the ABC for converting it completely to cordon dioxide. This hot expelled out gas is conditioned in the ESP and FD or GCT arrangements and then is released in the atmosphere.

1.3.2 Its role in the whole process

As the system proposed is not replacing any of the existing technology thus to describe the role in the whole process is not applicable.

1.4 Establishing the baseline for the equipment

1.4.1 Design and operating parameters

The present coal consumption for the production of sponge iron is given in the Table 1.4. The coal consumption depends on the production per batch which can be considered to be 24 hours per day.

1.4.2 Coal consumption in existing system

The coal consumption in the process of sponge iron manufacturing the units having at least one 50 TPD kiln is given below with the specific coal consumption of the unit.

Table 1.4 Coal consumption of Sponge iron Cluster

S. No	Name of Industries	TPD	No. of 50 TPD Kiln	No. of 100 TPD Kiln	Annual Production	Annual Coal consumption (from coal of CV 3000 kcal/kg)	Specific Coal Consumption (tons of coal/ tons of Sponge iron)
1	Agrasen Sponge Iron Pvt. Limited	150	1	1	42154	65573	1.56
2	Bajrang Ispat Limited	100	2		29900	40210	1.34
3	Bhagbati Steels Pvt Ltd	50	1		11200	15062	1.34
4	Jaganath Sponge Private Limited	50	1		14800	20086	1.36
5	Kendriya Ispat Pvt .Ltd	50	1		11850	15936	1.34
6	Maa Tarani Industries Private Ltd	100	2		27400	36848	1.34
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8	Meta Sponge Private Limited	100	2		26400	35503	1.34
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12	Shri Balaji Metallics Pvt Ltd	100	2		28900	38533	1.33
13	T.R Chemicals Limited	150	3		46800	62938	1.34
14	Utkal Metallic Limited	100	2		25689	34547	1.34

1.4.3 Operating specific coal consumption of existing system.

The detailed energy audit studies had been undertaken in various units of the cluster to evaluate the specific coal consumption in the cluster. Based on the installed TPD the specific energy consumption varies from 1.36 to 1.56 tons of coal to tons of production. On installing the fuel economizer there is a reduction of coal consumption by 5% of that of the present coal consumption.

1.5 Barriers for adoption of new and energy efficient technology / equipment

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of the fuel economizer in the cluster are:

- Lack of awareness of fuel economizer for ore pre heating.
- Misrelating fuel economizer by preheating kiln which requires high cost as compare to the pre heating kiln.

1.5.2 Financial Barrier

Implementation of Fuel Economizer requires high investment compare. Hence, many of the owners don't show interest due to high initial investment. Further, lack of awareness of such fuel economizer applications for pre heating of the ore and dolomite mixtures.

Energy Efficiency Financing Schemes such as SIDBI's, if focused on the cluster, will play a catalytic role in implementation of identified energy conservation projects & technologies. The cluster has significant potential for implementing the fuel economizer.

1.5.3 Skilled manpower

Not applicable

1.5.4 Other barrier(s)

Information on energy efficient technologies is not available among cluster unit owners, though the suppliers are available in near by states to the sponge iron cluster. Such technology has a substantial potential to save coal consumption in the cluster

2. TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of technology/equipment selected

2.1.1 Description of equipment

The project activity is installing the Fuel Economizer in the existing operation. This arrangement uses to recover the waste heat of the exhaust flue gas coming out from the ABC outlet is feed in the Fuel Economizer chamber for pre heating the iron ore and dolomite mixture at the feeding end of the kiln. The flue gas contains the heat content which is considerable to recover by adopting the proper heat recovery system. The sensible heat of the flue gases can be recovered to an extent. Complete recovery of waste heat is neither theoretically possible nor economically viable and hence only optimum quantity of the heat is recovered during this process. The fuel economizer has following special features:

- The production of the existing kiln increases minimum of 20%.
- Coal consumption of the plant decreases significantly.
- The most effective feature implementation point of view is that it does not require any additional space for installation.
- It significantly reduces the effect the temperature of the flue gases expelling out in the atmosphere.

2.1.2 Technology /Equipment specifications

The detailed specification of the Fuel Economizer suggested is furnished in table 2.1 below:

Table 2.1: Fuel Economizer Specifications

S. No.	Specifications	UNIT	Data
1	Installed with Kiln Type	TPD	50
2	Model	AAG	3334
3	Bed Depth	mm	100
4	Stroke/Min		2 - 3
5	Required Hot gas	m^3/hr	2600
6	Expected Increase in production	%	20

2.1.3 Justification of the technology selected & Suitability

The flue gas coming out of the reduction kiln is having a very high thermal energy which not been used for any of the process activity. Further the high temperature content of the gas is made to cool down by the force draft fan in waste gas treatment zone which is then

fed to the ESP for the waste gas cleaning due to the environment concern. This technology is very useful for exchanging the heat of the waste flue gases for preheating the iron ore and dolomite mixture in the fuel economizer chamber and the mixture enter the kiln at a temperature of around 700^0C into the reduction kiln. As the temperature of the mixture has already risen, thus the mixture entering the kiln does not require any extra heat for preheating which in turns reduces the coal consumption equivalent to the energy supplied by the fuel economizer.

2.1.4 Superiority over existing technology/equipment

In the present process condition extra amount of energy is required to reduce the waste heat of the exhaust flue gas. This is the energy required to run the FD fans for cooling the flue gas for the safety of the environment. With the installation of the fuel economizer good amount of heat is absorbed for per heating ore and dolomite mixture. The on implementing this technology the process gets superior to the previous system by the following ways.

- The production increases by a minimum of 20% than the earlier.
- No changes required in the process thus with keeping the quality intact, increases the production.
- Coal consumption for the preheating of the iron ore and dolomite mixture in the preheating zone is not required after installation of the system thus reduces the coal consumption significantly resulting in cost reduction.
- Utilizes the waste energy of the flue gas which unused in the previous system.
- Reduces the environmental effect.

2.1.5 Availability of proposed technology/equipment

Such equipment suppliers are available and are already been installed in some of the sponge iron plants in Raipur. The detail of the supplier is provided in Annexure-6.

2.1.6 Source of technology/equipment for the project

The source of the technology is indigenous and is available.

2.1.7 Service/technology providers

A detail of supplier has been furnished in Annexure 6.

2.1.8 Terms of sales

No any specific terms and conditions

2.1.9 Process down time during implementation

The process down time for installation of Fuel Economizer is Zero due to no major changes required for installing this technology..

2.2 Life cycle assessment and risks analysis

The life of the economizer system is considered for 15 years. There is no risk involved as the technology is installed in few plant and running successfully the letters from those plant are attached in Annexure 8

2.3 Suitable unit/plant size in terms of capacity/production

The economizer is categorized by the following plant sizes they are 25 TPD, 50 TPD and 100 TPD if they are installed side by side and the flue gas output can be merged together from the out let of ABC.

3. ECONOMIC BENEFITS FOR THE INSTALLATION OF FUEL ECONOMIZER

3.1 Technical benefits

3.1.1 Fuel savings per year

Fuel economizer is installed at the exhaust end of the kiln after the after burning chamber where from the exhaust heat of the fuel gas is absorbed for pre heating of the iron ore and dolomite mixture and is fed at a temperature of 700^0 C, which was previously achieved at the pre heating zone of the kiln. Thus the coal consumption for pre heating the same is not required. 1548 tons of coal can be saved per annum by installing the fuel economizer.

3.1.2 Electricity savings per year

There is no such electricity saving achieved.

3.1.3 Improvement in product quality

There is no significant impact on the product quality.

3.1.4 Increase in production

There is an increase of approximately 20% in production capacity.

3.1.5 Reduction in raw material consumption

Not Applicable

3.1.6 Reduction in other losses

Not Applicable

3.2 Monetary benefits

The monetary benefit due to installation of fuel economizer for 50 TPD kiln is Rs. 46.43 lakhs per annum due to the reduction of coal consumption for the pre heating of the iron ore and dolomite mixture. A detail of the saving is given in Table 3.1 below:

Table 3.1: Energy and monetary benefits

S. No.	Parameter	Unit	Value
1	Present coal consumption by a typical 50 TPD kiln	Tons/annum	18500
2	Coal saving due to the fuel economizer AGG-3334	%	5
3	Total electrical energy savings	kWh/annum	1548
4	Monetary saving @ Rs 3000/ton of coal	Rs. annum (In lakh)	46.43

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

There is no such benefit achieved by AGG-3334.

3.3.2 Improvement in skill set of workers

The technology selected for implementation is fuel economizer AAG 3334 will create the awareness among the workforce on advancement of the waste heat recovery system and how it will reduce the total energy consumption by existing process.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

None

3.4.2 Reduction in GHG emission such as CO2, NOX, etc

The major GHG emission reduction source is CO_2. The technology will reduce coal consumption and emission.

3.4.3 Reduction in other emissions like SOx

No significant impact on SOx emissions.

4. INSTALLATION OF FUEL ECONOMIZER

4.1 Cost of technology/equipment implementation

4.1.1 Cost of technology/equipments

The total cost of Fuel economizer is estimated to be Rs. 140 lakhs, which includes all the required equipment and man power for the installation of the AGG-3334. Other details are mentioned in the quotation attached in Annexure 7.

4.1.2 Other costs

Other charges include cabling and panel modification. Project cost details are furnished in Table 4.1 below:

Table 4.1: Project detail cost

S. No.	Particular	Unit	Value
1	FUEL ECONOMIZER for 50 TPD	Rs in lakh	125
2	i. Design & Engineering and Development, ii. Supervision of , Erection and Commissioning, iii. No Load and Load Trial for 7 days Observation.	Rs in lakh	15
3	Total Investment	Rs in lakh	140

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at Rs. 35 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project, which is Rs. 105 lakh.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10.0% which is prevailing interest rate of SIDBI for energy efficiency related projects. The loan tenure is 5 years and the moratorium period is 6 months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with 20.05 lakh in the first year operation and increases to 21 lakh at the end of fifth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is Rs. 140 lakh and monetary savings due to reduction in coal consumption is Rs.46.43 lakh and the simple payback period works out to be 42 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10 % interest rate works out to be Rs. 13.74 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 13.57 %. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 28.62%. The average DSCR is 1.44.

4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

A sensitivity analysis has been worked out to ascertain how the project financials would behave in different situations like there is an increase in power savings or decrease. For the purpose of sensitive analysis, two scenarios are considered are.

- Increase in power savings by 5%
- Decrease in power savings by 5%

In each scenario, other inputs are assumed as constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Table 4.2: Sensitivity analysis

Particulars	IRR	NPV	ROI	DSCR
Normal	13.57	13.74	28.62	1.44
5% increase in power savings	15.44	21.13	29.35	1.50
5% decrease in power savings	11.66	6.35	27.80	1.37

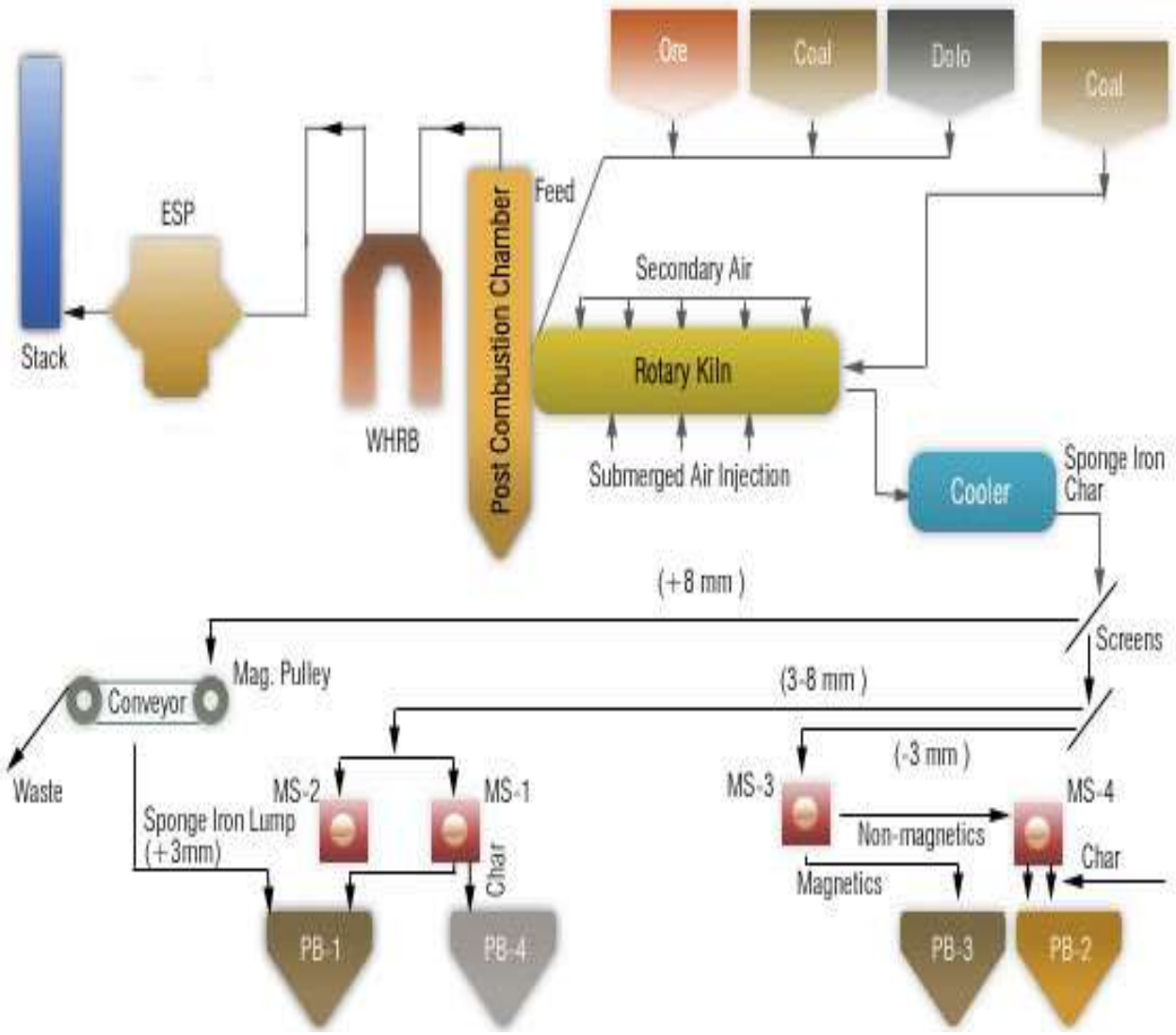
4.5 Procurement and implementation schedule

The project is expected to be completed in nine month from the date of release of purchase order. The detailed schedule of project implementation is furnished in Annexure 5.

ANNEXURE

Annexure 1: Process Flow Diagram

Process flow diagram will remain the same after implementation of proposed energy efficient motor.



Annexure 2: Detailed technology assessment report – Fuel Economizer for 50 TPD

S. No	Particulars	Units	Values
1	Capacity of kiln	TPD	50
2	Total Iron ore required for production of sponge Iron	TPH	3.75
3	coal Consumption	TPH	3.75
4	calorific Value of coal	kcal/kg	3000
5	Total heat supplied	kcal/hr	11250000
6	Quantity of flue gas available from kiln	nm^3/hr	12000
7	Density of hot air	kg/m^3	1.164
8	Sp. heat of hot gases	kcal/kg C	0.31
9	Flue gas Temperature from kiln outlet	C	950
10	Heat available from flue gas	kcal/hr	4113576
11	Initial temperature of Iron Ore	C	30
12	Temperature of Iron ore required in process	C	700
13	Sp. heat of Iron Ore	kcal/kg	0.22
14	Actual heat required to heat the Iron Ore	kcal/hr	552750
15	Flue gas supplied to pre heat the iron ore by 700 C	kcal/hr	552750
16	Quantity of coal saved	kg/hr	184.25
17	Total quantity of Coal savings due to pre heating	T/hr.	0.18
18	No of hours of operation	hrs/day	24
19	No of Days operation	days/year	350
20	Total coal Savings	Tons/year	1548
21	Monetary savings	Rs. In lakhs/year	46.43
22	Investment required	Rs. In lakhs	125.00
23	Payback period	Years	2.69

Annexure 3: Detailed drawing for civil work required for Fuel Economizer

SPONGYTECH
CONSULTING ENGINEERS PVT. LTD.
(AN ISO 9001:2008 Certified Company) Service Tax Registration No.: AAOCS5691JSD001
INCOME TAX PAN No. AAOCS5691J
JAS-ANZ
Accr.No.M3111204IN

PROPOSED INSTALLATION OF FUEL ECONOMIZER (AAG)

Head Office:- MIG-9/A "Dream-Villa"
C.G.H.B. Kota, RAIPUR – 492010 (Chhattisgarh) INDIA.
Ph.: +91-771-2575101, TELEFAX:- +91-771-2575310 [www.spongytech.com]
E-mail:- spongytech@gmail.com and stceplindia.steel@yahoo.com

Annexure 4: Detailed financial calculations & analysis

Assumptions

Name of the Technology	Fuel Economizer		
Rated Capacity	AAG - 3334		
Details	Unit	Values	Basis
No of working days	Days	350	
No of Shifts per day	Shifts	3	
Capacity Utilization Factor	%		
Proposed Investment			
Fuel Economizer	Rs. in lakhs	125	
Transportation and Erection Cost	Rs. in lakhs	15	
Total Investment	Rs. in lakhs	140.00	
Financing pattern			
Own Funds (Internal Accruals)	Rs. in lakhs	35.00	Feasibility Study
Loan Funds (Term Loan)	Rs. in lakhs	105.00	Feasibility Study
Loan Tenure	Years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%	10	SIDBI Lending Rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	2	Feasibility Study
Annual Escalation	%	2	Feasibility Study
Estimation of Revenue			
Coal savings	Tons/year	1548	
Coal cost	Rs./Ton	3000	Detailed calculations enclosed in DPR
St. line Depn.	%	5.28	Indian Companies Act
IT Depreciation	%	80.00	Income Tax Rules
Income Tax	%	33.99	Income Tax

Estimation of Interest on Term Loan **Rs. (in lakh)**

Years	Opening Balance	Repayment	Closing Balance	Interest
1	105.00	9.55	95.45	10.50
2	95.45	19.09	76.36	9.55
3	76.36	19.09	57.27	7.64
4	57.27	19.09	38.18	5.73
5	38.18	19.09	19.09	3.82
6	19.09	19.09	0.00	1.91
	Total	105.00		

WDV Depreciation **Rs. (in lakh)**

Particulars / years	1	2	3	4	5	6
Plant and Machinery						
- Cost	140.00	112.00	22.40	4.48	0.90	0.18
- Depreciation	7.39	7.39	7.39	7.39	7.39	7.39
- WDV	112.00	22.40	4.48	0.90	0.18	0.04

Projected Profitability **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	Total
Revenue through Savings							
savings in Coal	46.43	46.43	46.43	46.43	46.43	46.43	278.59
Total Revenue(A)	46.43	46.43	46.43	46.43	46.43	46.43	278.59
EXPENSES							0.00
O & M Expenses	2.80	2.80	2.80	2.80	2.80	2.80	16.80
Total Expenses(B)	2.80	2.80	2.80	2.80	2.80	2.80	16.80
PBDIT(A)-(B)	43.63	43.63	43.63	43.63	43.63	43.63	261.79
Interest	10.50	9.55	7.64	5.73	3.82	1.91	39.14
PBDT	33.13	34.09	35.99	37.90	39.81	41.72	222.65
Depreciation	7.39	7.39	7.39	7.39	7.39	7.39	44.35
PBT	25.74	26.69	28.60	30.51	32.42	34.33	178.30
Income tax	0.00	3.97	10.71	12.58	13.47	14.17	54.90
Profit after tax (PAT)	25.74	22.72	17.89	17.93	18.95	20.16	123.39

Computation of Tax **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6
Profit before tax	25.74	26.69	28.60	30.51	32.42	34.33
Add: Book depreciation	7.39	7.39	7.39	7.39	7.39	7.39
Less: WDV depreciation	112.00	22.40	4.48	0.90	0.18	0.04
Taxable profit	0.00	11.69	31.51	37.01	39.63	41.69
Income Tax	0.00	3.97	10.71	12.58	13.47	14.17

Projected Balance Sheet **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6
LIABILITIES						
Share Capital	35.00	35.00	35.00	35.00	35.00	35.00
Reserves & Surplus	25.74	48.46	66.35	84.28	103.23	123.39
Term Loans	95.45	76.36	57.27	38.18	19.09	0.00
TOTAL LIABILITIES	156.19	159.82	158.62	157.47	157.32	158.39
ASSETS						
Gross Fixed Assets	140.00	140.00	140.00	140.00	140.00	140.00
Less : Accm. depreciation	7.39	14.78	22.18	29.57	36.96	44.35
Net Fixed Assets	132.61	125.22	117.82	110.43	103.04	95.65
Cash & Bank Balance	23.59	34.61	40.80	47.03	54.28	62.75
TOTAL ASSETS	156.19	159.82	158.62	157.47	157.32	158.39
Net Worth	60.74	83.46	101.35	119.28	138.23	158.39
Debt Equity Ratio	2.73	2.18	1.64	1.09	0.55	0.00

Projected Cash Flow **Rs. (in lakh)**

Particulars / Years		0	1	2	3	4	5	6
Sources								
Share Capital		35.00	0.00	0.00	0.00			
Term Loan		105.00						
Profit After tax			25.74	22.72	17.89	17.93	18.95	20.16
Depreciation			7.39	7.39	7.39	7.39	7.39	7.39
Total Sources		140.00	33.13	30.11	25.28	25.32	26.34	27.55
Application								
Capital Expenditure		140.00						
Repayment Of Loan		0.00	9.55	19.09	19.09	19.09	19.09	19.09
Total Application		140.00	9.55	19.09	19.09	19.09	19.09	19.09
Net Surplus		0.00	23.59	11.02	6.19	6.23	7.25	8.46
Add: Opening Balance		0.00	0.00	23.59	34.61	40.80	47.03	54.28
Closing Balance		0.00	23.59	34.61	40.80	47.03	54.28	62.75

IRR **Rs. (in lakh)**

Particulars / months	0	1	2	3	4	5	6
Profit after Tax		25.74	22.72	17.89	17.93	18.95	20.16
Depreciation		7.39	7.39	7.39	7.39	7.39	7.39
Interest on Term Loan		10.50	9.55	7.64	5.73	3.82	1.91
Cash outflow	-140.00	-	-	-	-	-	-
Net Cash flow	-140.00	43.63	39.66	32.92	31.05	30.16	29.46
IRR	13.57%						
NPV	13.74						

Break Even Point **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6
A. Variable Expenses						
Operation & Maintenance Exp (75%)	2.10	2.10	2.10	2.10	2.10	2.10
Sub Total	2.10	2.10	2.10	2.10	2.10	2.10
B. Fixed Expenses						
Operation & Maintenance Exp (25%)	0.70	0.70	0.70	0.70	0.70	0.70
Interest on Term Loan	10.50	9.55	7.64	5.73	3.82	1.91
Depreciation	7.39	7.39	7.39	7.39	7.39	7.39
Sub Total	18.59	17.64	15.73	13.82	11.91	10.00
C. Sales	46.43	46.43	46.43	46.43	46.43	46.43
D. Contribution	44.33	44.33	44.33	44.33	44.33	44.33
E. Break Even Point (B/D)	0.42	0.40	0.35	0.31	0.27	0.23
F. Cash Break Even	0.25	0.23	0.19	0.14	0.10	0.06
G. BREAK EVEN SALES	19.47	18.47	16.47	14.47	12.47	10.47

Return on Investment **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	Total
A.Net Profit Before Taxes	25.74	26.69	28.60	30.51	32.42	34.33	143.97
B.Net Worth	60.74	83.46	101.35	119.28	138.23	158.39	503.07
	28.62						

Debt Service Coverage Ratio **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	Total
CASH INFLOW							
Profit after Tax	25.74	22.72	17.89	17.93	18.95	20.16	123.39
Depreciation	7.39	7.39	7.39	7.39	7.39	7.39	44.35
Interest on Term Loan	10.50	9.55	7.64	5.73	3.82	1.91	39.14
TOTAL	43.63	39.66	32.92	31.05	30.16	29.46	206.88
DEBT							
Interest on Term Loan	10.50	9.55	7.64	5.73	3.82	1.91	39.14
Repayment of Term Loan	9.55	19.09	19.09	19.09	19.09	19.09	105.00
TOTAL	20.05	28.64	26.73	24.82	22.91	21.00	144.14
Average DSCR	1.44						

Annexure 5: Details of procurement and implementation plan

Project Implementation schedule

S. No	Activity	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10
1	Placement of Orders for Equipment										
2	Manufacturing										
3	Erection and commissioning										
4	Trial runs										

Annexure 6: Details of technology/equipment and service providers

Equipment details	Source of technology	Service/technology providers
Fuel Economizer	Indian	Sponge Tech Consulting Engineering Private Limited Raipur- 492010 (C.G) Tel: 0771-2575101 Email: stcepl_2010@yahoo.com spongytech@gmail.com Web: www.spongytech.com

Annexure 7: Quotation or techno-commercial bid

SPONGYTECH
CONSULTING ENGINEERS PVT. LTD.
(AN ISO 9001:2008 Certified Company) Service Tax Registration No.: AAOCS5691JSD001
INCOME TAX PAN No. AAOCS5691J
JAS-ANZ
Accr.No.M3111204IN

Ref.: STCEPL/APITCO/11-12/002 Date: 11.10.2011

To,

M/s. **APITCO LTD**
8th Floor, Parisrama Bhavan,
Bhasheerbagh, Hydrabad (A.P)- 500004
Tel:040-23237333,23237981,23243611
Fax:040-23298945, Mob: 09032820875
E-mail: ayan.ganguly@apitco.org

Kind Attn.: Mr. AYAN GANGULY

Sub.: Quotation for "AAG" Fuel Economizer.

Dear Sir,

With reference to your enquiry, we are submitting herewith our best price for your kind consideration:-

Sl. No.	Item Description	Unit	Qty.	Rate / unit (Rs. Lacs)	Amount (Rs. Lacs)
01	(a) "AAG" Fuel Economizer model – 3334 complete assembly suitable for 50TPD existing sponge iron kiln	Set	One	125.00	125.00
	(b) Taxes & duties	Additional as applicable at the time of delivery.			
02	(a) "AAG" Fuel Economizer model – 3336 complete assembly suitable for 100TPD existing sponge iron kiln	Set	One	170.00	170.00
	(b) Taxes & duties	Additional as applicable at the time of delivery.			
03	• Design & Engineering and Development, • Supervision of , Erection and Commissioning, • No Load and Load Trial for 7 days observation.	Set	One	Rs. 15,00,000.00 (Rupees Fifteen Lacs Only) Additional each equipment	

Note:

1) The price quoted is ex-works Raipur.
2) The quoted price is valid for three months only (11.10.2011).
2) Transportation and transit insurance is to be borne by **Customer**.
3) The equipment will be supplied in complete assembled condition.
4) The raw material (Iron ore) feeding system to be modified as per site conditions (**Customer** Scope). However modified drawings will be provided by STCEPL.

Head Office: - MIG-9/A "Dream-Villa"
C.G.H.B. Kota, RAIPUR – 492010 (Chhattisgarh) INDIA.
Ph.: +91-771-2575101, TELEFAX: - +91-771-2575310 **[www.spongytech.com]**
E-mail:- spongytech@gmail.com and stceplindia.steel@yahoo.com

SPONGYTECH
CONSULTING ENGINEERS PVT. LTD.
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INCOME TAX PAN No. AAOCS5691J
JAS-ANZ
Accr.No.M3111204IN

Delivery Schedule: -

1) Equipment complete - Six months from the date of firm order received at **STCEPL** Raipur.
2) Erection and Commissioning - Three months (partially the work can be carried out simultaneously)

Payment Term:-

1) 50% of the Total cost of equipment along with order.
2) 30% of the Total cost of equipment after manufacture at the time of dispatch.
3) 10% of the Total cost of equipment on completion of erection.
4) 5% of the Total cost of equipment on completion of commission.
5) 5% of the Total cost of equipment on successful commercial production.

Scope of Works:-

1) Design, manufacturing & supply by **STCEPL** Raipur.
2) Supervision of erection by **STCEPL** Raipur.
3) Supervision of commissioning by **STCEPL** Raipur.
4) Trial run under the supervision of specialized technocrats of **STCEPL** Raipur.
5) 20% of the optimum increased commercial production continuously for three days.

Other Terms & Conditions:-

1) The total no. of 03 technocrats of **STCEPL** Raipur will be deputed at site during erection.
2) The process expert of **STCEPL** Raipur will be deputed at site for seven days to monitor the operation to achieve the guaranteed output.
3) Boarding & lodging with site office is to be provided by the M/s. Customer during erection commissioning and trial run.

Thanking you
For STCEPL,

A.C. VERMA
Jt. Managing Director
Cell No. +91 94060 31009
Skype ID: awinash.verma1

Head Office: - MIG-9/A "Dream-Villa"
C.G.H.B. Kota, RAIPUR – 492010 (Chhattisgarh) INDIA.
Ph.: +91-771-2575101, TELEFAX: - +91-771-2575310 **[www.spongytech.com]**
E-mail:- spongytech@gmail.com and stceplindia.steel@yahoo.com

Annexure 8: Letters from reputed industries regarding Fuel Economizers

From: Rahul M Garg [rahulmgarg@jspl.com]
Sent: Wednesday, August 08, 2007 12:45 PM
To: verma@spongytech.com
Subject: Your AAG Fuel Economiser technology for Sponge Iron

Dear Mr. Verma,

We are glad to know about the new technology you have developed in the field of sponge iron. We at Jindal Steel & Power Ltd. are manufacturing sponge iron & are having kilns of capacity 100, 350 &, 500TPD at Raigarh. Further for our expansion plans & development in the existing plant we would like to know the technology developed.

Please quote us your best price for all the modules available. Also we would appreciate if you come & discuss on the above mentioned subject.

We would like to have your presentation on the subject.

Thanks & Regards,

R.M.Garg,
AGM Projects.

From: V.R.Sharma
To: raghuchandran@spongytech.com
Sub.: Reg. Business possibilities

Dear Mr.Govind R.Chandran,

As you know, I have joined Bhushan Power & Steel Limited as Joint Managing Director. We have four numbers of sponge iron units in Jharsuguda near Raigad. I visit Jharsuguda 2-3 days in a week and stay there. During my next visit which is likely to take place on 23rd & 24th August, 2007. We can meet in Jharsuguda if you can spare some time.

The Jharsuguda station is one hour by train from Raigarh.

Regards

V.R.SHARMA

My new contact details are as under:

V.R.SHARMA
Jt. M.D.
BHUSHAN POWER & STEEL LTD.,
4th FLOOR, TOLSTOY HOUSE,
15-17 TOLSTOY MARG,
CONNAUGHT PLACE,
NEW DELHI 110 001.

Subject:	visit to JSPL for demonstration of AAG fuel economiser
Date:	Fri, 24 Aug 2007 15:26:03 +0530
From:	"Rahul M Garg" <rahulmgarg@jspl.com> View Contact Details
To:	verma@spongytech.com, govindraghuchandran@yahoo.co.in
CC:	"Damodar Mittal" <dmittal@jspl.com>

Sir,

As discussed with you over phone we are sorry to say that we are unable to reach to your place due to prior decided programme. Further we would appreciate if you can come to JSPL on 29th of this month (i.e. Wednesday) to discuss on the above mentioned subject.

Thanks,

R.M.Garg,

AGM Projects.